

**Technology in Accounting: Disruptive Innovations and Implications**

**An Honors Thesis (HONR 499)**

**by**

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## **Abstract and Acknowledgments**

### **Abstract:**

Accounting has been used in varying forms since the beginning of humankind. Every innovation in technology has forced accountants to adapt but ultimately improved the effectiveness of accounting systems. With new developments in technology occurring ever more quickly, the role of accountants is changing at a speed unlike any seen before. The day to day work flow of accountants is experiencing a revolution, and therefore the education of accountants must also revolutionize. This paper analyzes the latest innovations and their impacts, both positive and negative on the industry as a whole.

### **Acknowledgments:**

I would like to personally thank Dr. Jason Stanfield for being my advisor throughout this project. He was able to encourage me during the process and point me in the right direction. I would also like to thank the Ball State Accounting Department as they have been very welcoming and supportive throughout the last four years.

## **Process Analysis Statement**

The process of writing this thesis has brought to light how relevant this topic is to my work-related future. I found the articles reviewed and cited intriguing and each offers unique perspectives and facts which I would not have thought of independently. As I am about to enter my first year as an accountant at a large public accounting firm in roughly 6 months, I cannot help but wonder if the findings I derived from my research, and the predictions of the long-term implications of so many disruptive technologies, will hold true. Throughout the time I have been researching and writing I have shaped my own opinion on the key attributes and skills that I will need to develop and strengthen to ensure that I am as well suited as possible to enter and succeed in such a dynamic work environment.

I have learned a few important things about myself over the past few months while working on this paper. One idea that particularly sticks out to me is that I am thrilled to start a new chapter of my life. Being a student has been a huge component of my identity, and while I will continue to learn on the job, I am excited to put my hard-earned skills to use on real-life situations and problems. The impact of succeeding at a public accounting firm will be much different than succeeding at a test or project for a class.

## **Technology in Accounting**

As a society, we are experiencing a time of tremendous change and great opportunity due to advances in technology. These changes are causing, and will continue to cause, disruption in all types of industries. However, with great disruption to an industry comes unforeseen consequences which may not always be positive in nature. Accounting is an industry which will continue to be revolutionized by these technological advances. The most rapid changes in current times are coming from the development and implementation of artificial intelligence (AI), Robotic Process Automation (RPA), and other groundbreaking technologies.

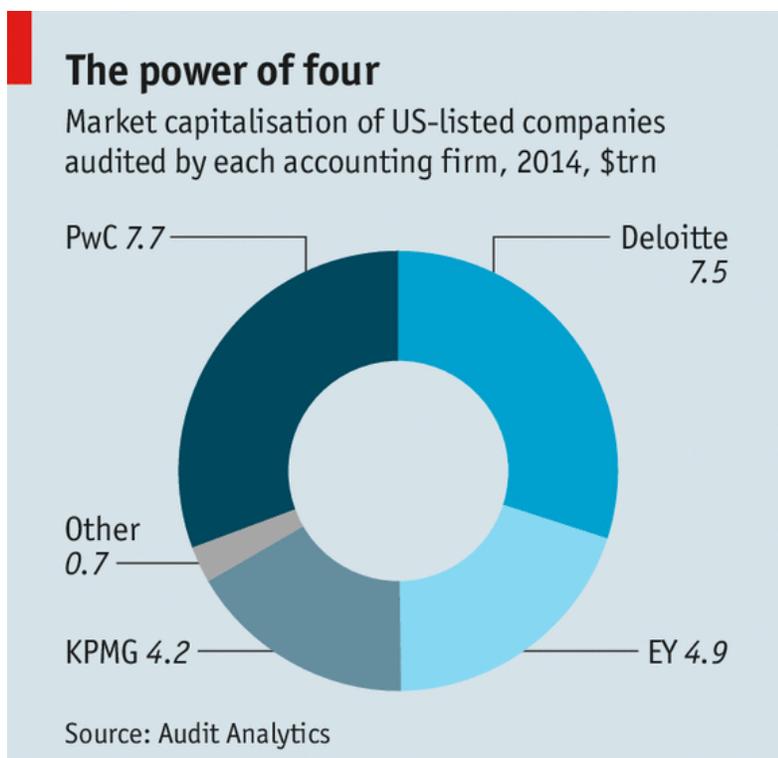
The changes from utilizing these modern technologies will affect the education, hiring, and day to day operations of an accountant, and more specifically, Certified Public Accountants (CPA's). By obtaining a deeper understanding of what major technological changes are occurring in the industry, this will provide some insights into the consequences, both positive and negative, which will affect an accountant starting his/her career.

From the use of the abacus to aid in measuring and recording transactions, accounting has been constantly subject to major overhauls from the use of technology. The development of computers, the World Wide Web, cell phones, and tax software have forced accountants to hone new skills in order to add value to clients and remain relevant. With all of the previous technological advancements, accountants have found a way to continue being valuable. However, artificial intelligence and robotic process automation may be the largest obstacles accountants have ever faced to staying relevant.

One thing is for sure: Change is coming and much of it is already here. Large public accounting firms are spending millions of dollars each year on research and development of

these technologies. Ernst & Young, EY, is one of the public accounting firms leading the charge with its recent announcement that it will be spending an extra “1 billion dollars on new technology, including artificial intelligence and shifting platforms to the cloud.” This capital allocated to research and development is in addition to the roughly 1 billion dollars EY already spends annually on technology. This allotment of cash has forced other members of the “Big 4” accounting firms to invest large sums of money to stay competitive in the innovation field (Turner, 2018). The investments made by these accounting firms are essential because the technologies being innovated today will determine which firms will have a competitive edge in the not-so-distant future.

The other members of the Big 4 in addition to EY are: Pricewaterhouse Coopers, Deloitte, and KPMG. The moniker Big 4 refers to the large size differential between these four firms and the fifth largest firms. As a collective these firms dominate the market for audit



services for large, publicly-traded companies. This chart from Audit Analytics illustrates how the Big 4 have cornered the market with the combined total market capitalization audited by other firms not breaking 1 trillion dollars, with the smallest “Big 4” firm at 4.2 trillion dollars (The Economist, 2014).

These largest firms have all taken action to push the use of technology in public account forward. For example, Pricewaterhouse Coopers purchased a large amount of equity in a Chinese startup, VeChain Global Technology Holding Ltd. This company specializes in blockchain, supply chain management, and anti-counterfeiting.

Deloitte recently purchased the assets of ATADATA. This organization provides a cloud platform that “maps, migrates and manages workloads in any combination of on-premise and cloud environments.” Even before this, Deloitte formed an alliance with Amazon Web Services to build a 2,500 global AWS cloud-based practice. This alliance allows Deloitte to move the bulk of its data and work papers into cloud-based servers and enables employees to access, edit, and save all the necessary files to perform their audit services at the click of a mouse.

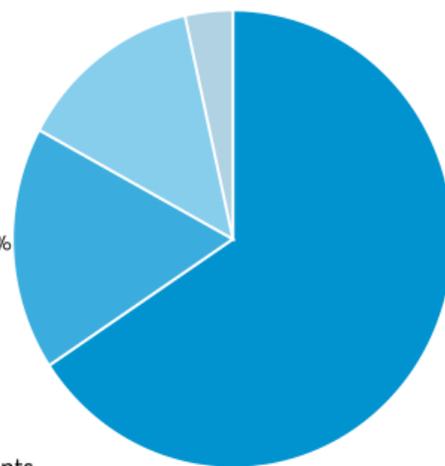
KPMG matched the moves of its competitors by acquiring the identity and access management arm of Cyberinc. This branch specializes in the management of digital consumer identities and privileged user management (Alexandre, 2018).

This chart shows the results from a poll given by the Institute of Management Accountants (IMA). The results demonstrate the importance of staying ahead of the curve as 65.7% of management accountants feel it is the

## Data analytics making headway

Enhancing analytics capabilities is seen as a key to future success for 2/3 of respondents

- Key to gaining competitive advantage, 65.7%
- Helps maintain market position, 17.2%
- Evaluating costs and benefits, 13.6%
- Comfortable with way things are currently done, 3.5%



Source: Institute of Management Accountants

key to gaining a sustainable competitive advantage in the future. Only a small percentage, 3.5% feel comfortable with the way things are done. This exemplifies the continuing need for further development of technology (Cohn, 2019).

In order to dive into the implications of these groundbreaking technologies, one must know the characteristics of each type of disruptive technology. Artificial Intelligence in accounting can be defined as "...technology that enables computers to perform decision-based tasks previously left to humans. It shows up in multiple forms, including machine-based learning that can progressively become better at analysis and decisions the more it is used, and speech-based technology that can understand different voices and languages" (Ovaska, 2017).

Artificial intelligence can be very powerful and is constantly improving. This broad term describes technologies capable of providing outputs that can be extremely efficient, and frequently can supersede human efforts in both accuracy and precision. However, AI does not replicate, or replace, human intelligence. As accounting firms push forwards with the development and implementation of such technologies, one must keep in mind the strengths and limits of this different form of intelligence and build an understanding of the best way for humans and computers to work together.

In contrast, robotic process automation (RPA) is "...a preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management" (Moffit, Rozario, & Vasarhelyi, 2018). The technologies differ in the fact that AI has the ability to learn from previous examples and is able to better solve/approach the problem the next time it

is encountered, whereas RPA does not inherently improve its ability to make decisions unless a change is programmed in the software by a human technician.

RPA “bots” have become commonplace in large public accounting firms for several years and are more commonly referred to as “software bots”. These processes are used very often in practice in the form of tax software that “plugs and chugs” raw information that is input from a user and then calculates an answer. RPA’s also frequently review immense sets of client data and transactions to determine the relevance or impact each piece of information has on the client’s financials. However, RPA is not limited to just tax software or reviewing large amounts of data. Robotic process automation is expanding into all aspects of the assurance services offered by public accounting firms.

While RPA’s continue to grow in prevalence and sophistication, emerging AI is being continually developed and is now seeing practical implementation. A large portion of the money being funneled into technology development by firms is dedicated to AI. Although artificial intelligence is not being used as prevalently as RPA’s, AI has significant upsides and potential and is being used in incremental but increasing ways. AI is implemented in small doses, then tested for accuracy and fine-tuned for any necessary changes. Once perfected, artificial intelligence will be the gold standard for firms to have to ensure cost effectiveness, audit quality, and efficiency.

However, with the positive benefits of these technologies comes drawbacks. Newly-minted accounting graduates no longer practice tedious “ticking and tying” tutorials, repetitive substantive testing after following countless paper trails, and gathering source documents face-to-face from clients. These tasks were previously standard assignments for early-career accountants which developed and refined skills and accounting acumen. Instead, recent hires are

skipping what most senior accountants did for the first one to three years of their careers. This demand for young accountants to provide value beyond the expectation of completing tedious work requires the new hire to have skills that entry level accountants have not possessed before. In order to acquire these additional skills an individual must either have supplementary education from a University, or substantial on-the-job training from the employer.

Many argue that this is a great use of innovation; to cut out the rudimentary, task-oriented work, allowing accountants to focus on more strategic tasks. This is true. However, the rudimentary work teaches young accountants the base knowledge which more advanced topics are built. I completed an internship at Ernst and Young, one of the “Big 4” accounting firms, and I experienced first-hand the monotony of going through a work papers and ticking and tying numbers together, but this certain task was essential to my understanding of the overall audit/assurance process. It takes time and repetition to be able to dive into the details of a work paper to ensure the accuracy of the information and understand the “bigger picture” of why these tests are being done and what the results actually mean.

To more experienced accountants these tasks are dull and trivial. However, to junior level accountants, like myself, exposed to public accounting work for the first time, these basic tasks are challenging and fulfilling. If I had not gone through and performed these elementary tasks numerous times, I would not understand the relationship between various work papers and the importance of checking the details. By building a strong foundation, no matter the level of monotony or replicability of the work, an individual with a long-term goal of mastering accounting skills will be better off.

These tasks described above are only the beginning as there are a multitude of tasks that will be replaced by the likes of AI and RPA. With the more rudimentary work disappearing,

what will the entry level work load consist of for accountants of the not-so-far-off future?

Richard Anning, the Head of IT for the ICAEW conveyed this same idea, “If a lot of the lower level, process type junior work might be automated, it is a bit of an issue for individuals to get experience” (Institute of Chartered, 2017).

Offshoring is another avenue in which repetitive work is being channeled away from entry-level accountants in U.S. public accounting firms who are newly entering the professional accounting workforce. There are “accounting teams” in place who are located in parts of the world where the cost of labor is much cheaper than the United States or European countries. These off-site teams often complete routine tasks such as filling out work papers or forms in order to alleviate the amount of repetitive work that higher skilled, but more costly accountants would otherwise need to do.

Basic tasks mentioned above such as filling out forms, ticking and tying work papers, and pulling data files from an online database are quickly disappearing. Similar to the consequences of AI, this outsourcing of basic tasks eliminates the bulk of a current first years’ learning experience. While this is helpful in allowing the accountant to focus on “bigger picture issues”, there is no substitute yet in place for replacing the learning connections and technical abilities developed along the way. If there were to be some complication with technology or major political rift which forced these offshore teams to be unreachable, the once easy tasks of filling out forms or pulling documents from the cloud would be returned to unprepared entry-level accountants.

One certain implication of technology and offshoring basic work is that entry-level accountants must become much more proficient with technology. According to an article by MGI Worldwide, it is commonplace for subjects such as information technology to be

implemented into the curriculum for accounting majors and even doctorate-level individuals in the accounting industry (MGI Worldwide, 2016). In order to be successful in the coming years, individuals will need to be able to leverage their proficiency with software and database management with their knowledge of financial regulations and interpretation of fiscal matters.

The change towards a more technological-orientated background can be seen in new graduate degrees being offered such as the master's degree in data analysis and analytics in accounting now offered by several universities. Accounting analytics is defined as "the application of data analytics and big data technologies to the field of accounting. In addition to helping accountants manage typical tasks, accounting analytics enables "financial professionals to answer business questions, shape corporate strategy, and forecast financial trends" (Master's in Data, 2019). Technology is being implemented into the core curriculum of colleges across the globe. Ball State University is one of the many Universities partaking in this movement. Ball State offers several business-related courses specializing on the use of software to aid in making business decisions. There is one particular system which sticks out more than others for accountants, Microsoft Excel.

A mastery of this system is essential to individuals starting their career as Excel's prevalence in all forms of business, especially accounting is undeniable. This is the software which I utilized the most this past summer working for EY. Several colleagues had pieces of paper filled with Excel shortcuts pasted to the wall in front of them in order to attain efficiency in the software.

Education as a whole is becoming prolonged in regard to accounting. With basic tasks being eliminated it is only reasonable that a student will be required to be taught additional or more strategic skills to still be able to continue to add value. The graph below shows a drastic increase year over year in the number of accounting students gaining a master's degree before joining the work world. This

massive increase is considerable

considering that there was no

change in requirements for

students to attain more credit

hours before acquiring a CPA or

a job opening (Firm of the Future,

2019).

In addition to more education becoming popular, public accounting firms are hiring students with different

educational backgrounds. Data scientists are being hired at an unprecedented rate. KPMG, another member of the Big 4 accounting firms, has taken additional steps to ensure it is a step ahead in regard to data analytics. KPMG has partnered with several universities to develop a master's degree curriculum that enhances student's analytics skills with a focus on predictive, diagnostic, and prescriptive analytics. This program covers tuition, living expenses, and also contains an internship with KPMG (Master's in Data, 2019).

**Number of Master's Degrees Awarded (U.S. Only)**



KPMG is not the only member of the Big 4 pouring a myriad of resources into hiring and developing data scientists. PricewaterhouseCoopers is another member of the Big 4 who offers data science programs to all of its employees. These programs are firm sponsored and range from beginner to master level certifications. The courses focus on “hot button” fields such as Artificial Intelligence, data analysis, and data mining (Coursera, 2019).

It is clear that a more advanced level of technological proficiency will be essential to a successful career in the future of public accounting, but what will the day to day operations entail? With simple work being either completed by RPA’s, AI, or off-shore teams, the majority of a CPA’s work will be concentrating on developing client relationships. Being more highly skilled than entry-level accountants in the past, present-day entry-level accountants will find themselves face-to face to clients asking follow-up questions or discussing client problems which the accounting firm has the ability to solve with other services. Instead of a 3<sup>rd</sup> year accountant reviewing the work paper of an intern or first year staff, that professional may consider the tax consequences of moving a corporate headquarters, the implications of acquiring another corporation, or how the financial statements of a Fortune 500 company may look after the spin-off of a business unit into its own IPO, all work previously reserved for more experienced staff and partners.

There is no disputing that an increase in technological productivity will result in a changed role for accountants. Accounting has always served individuals and companies by providing the fairest presentation of financial information. This in turn allows the best business decisions to be made. While the role of compiling and presenting this financial information may change, there will be an everlasting need for savvy business individuals to interpret the output and ensure that the accounting systems which gather, test, and present the data are operating

soundly. A Certified Public Accountants most valued asset, not only to the client but also to the public, is the trust and integrity that his/her signature brings when signing off that the financial statements are fairly represented and that there are no material deficiencies in the corporation's internal controls.

It is not a stretch of the imagination that AI systems of the future will reach a level of proficiency that will displace some of the jobs available to CPA's, however, that day may not come for decades. The long-term role of public accountants is nearly impossible to predict as the future and potential of artificial intelligence remains an unknown. In the short to mid-term it is an absolute that there will be a tremendous need for individuals with strong technical accounting skills, coupled with strong technological capabilities (Gregory, 2019). These individuals will be best suited to capitalize on the changing industry.

The accountants which fill this short to mid-term void will be utilizing technology to complete a number of different tasks. In an article titled, "Artificial Intelligence and the Future of Accountancy" the ICAEW, Institute of Chartered Accountants in England and Wales, states that technology is aiding accountants in three categories:

- providing better and cheaper data to support decision-making
- generating new insights from the analysis of data
- freeing up time to focus on more valuable tasks such as decision-making, problem solving, advising, strategy development, relationship building and leadership (Institute of Chartered, 2017).

Certified Public Accountants have long since been seen as the individuals who simply work through endless documents and then present final numbers to their clients. While this might be public perception, accountants have been acting as expert decision-making aides to their

clients for over a century. Whether those clients are Fortune 500 conglomerates or a middle-class family getting their taxes done, CPA's can make a meaningful impact.

CPA's provide value through applying their specialized knowledge in ever-changing situations, as well as, being able to rely on their extensive training and experience to provide quick decisions for clients who face pressing issues. The most lethal weapon which a CPA yields over any piece of technology in the near future is trust. Having a highly-trained individual with numerous years of experience give a clean audit opinion gives creditors and investors a peace of mind that an artificial intelligence system may not be able to replicate in the foreseeable future. According to Scientific American, "Human trust is often based on our understanding of how other people think and having experience of their reliability. This helps create a psychological feeling of safety. AI, on the other hand, is still fairly new and unfamiliar to most people. It makes decisions using a complex system of analysis to identify potentially hidden patterns and weak signals from large amounts of data." This lack of understanding of how AI comes to its conclusions leads to its conclusions carrying less merit/trust than those came to by a seasoned audit partner who has been auditing the same client for the past 20 years (Polonski, 2018). It is these characteristics, both tangible and intangible, which make CPA's irreplaceable in the short to mid-term.

A specific example of a change which is occurring presently due to the implementation of advanced audit technology is that the amount of transactions or samples an auditor can test has increased immensely. In the past an auditor would choose to substantively test only a portion of the transactions a business participates in. It is too time intensive, and would be counterproductive from a cost standpoint, to pay to test amounts which are immaterial. This inability to test all transactions brings rise to what is known as "sampling risk". The risk that the

selected transactions which are tested are not actually representative of the all transactions and therefore might lead the auditor to an incorrect conclusion.

However, with the computing ability of AI and RPA's and the prevalence of detailed transaction data from the modern AIS, it is now possible to test every transaction. High computing speeds and lack of need for human time dedicated to processing, it now takes CPA's less time to accumulate and review every transaction than it used to take to just check the large, material transactions. Audit technology has also already adapted to identify and alert the auditor of any unique transactions that occur. This ability for technology to adapt based off past experiences is referred to as machine learning. This enables auditors to focus their attention on financial transactions which are the most "inherently risky" in nature.

Another important procedure of public accounting that has changed due to advanced technology is the auditor's ability to dive into more strategic roles than ever before. Now that monotonous tasks are being replaced and entry level accountants are able to do the work of high-level CPA's, the manager and partner level individuals are able to expand to tasks that didn't exist in the past.

As stated previously, the level of impact technology will have on any individual accountant will depend on the skill set of the individual. In an article published in the *Journal of Information Systems*, the author explores the impact information technology has on public accounting firms. The authors interviewed auditors at different levels within the public accounting hierarchy to analyze the impact information technology has on their day to day activities (Pepe, 2011)

The entry level auditor, who is in charge of preparing work papers and performing repetitive tasks, stated that IT had a large impact on saving time and reducing errors. Often times

an entry level accountant will have to analyze two separate work papers to ensure the invoice matched the payment received. After going through countless invoices, it is well within human nature to skim the numbers and lose concentration. IT plays a large role by efficiently processing these work papers and comparing the dollar amount to the penny without the possibility of human error when there is a lapse of concentration.

An auditor who has achieved a senior title serves as the organizer of the audit. The senior accountant aids in planning the audit, assigns tasks, and notifies the proper manager when a work paper requires a signature. Information Technology and audit software has been instrumental in aiding all of these processes. From my experience at EY, the audit software contained all of the necessary steps, work papers, and prior year documents to serve as a reference. In addition, the software allowed seamless transitions between being assigned a task and then handing off the task to be reviewed by a more senior level accountant. The software displays the completion percentage of the audit, as well as contains entire libraries of resources, which can be used as guidance to calculating materiality or other subjective activities.

An accountant at the senior level is one of the most valuable to an engagement team. The role of a senior level account has changed drastically due to technology. Not only is the individual at this level able to communicate and work more efficiently with the team, but also is able to expand the roles of this position to ones that were usually entrusted to manager level.

While the audit manager benefits from the AI, software, and information technology, it is in a much less drastic manner. The audit manager has always focused on more strategic tasks compared to the data crunching, which all accountants begin with. However, in the same Journal of Information Systems article, the author states, “all audit evidence collected by juniors and seniors is in electronic format, which allows the audit managers to be more effective when

reviewing the data” (Pepe, 2011). The audit managers I worked around were notified immediately by the audit software when a workpaper was completed and ready for review. The manager was then able to leave any review notes or recommendations and can easily hand the workpaper back off to the junior/senior accountant to revise.

Managers are now able to rely on more accurate information, in a timelier manner, to solve problems that previously businesses never knew existed. Technology has freed the time and focus of the highest echelon of CPA’s. The C-suite of corporations do not make long range planning and big decisions based on qualitative data alone. Certified Public Accountants are skilled in the areas of managerial and cost accounting are relied on to support the generation of strategic roadmaps, high level tactics, and policies with information derived from the company’s financial data. The role of managerial/partner level accountants is so important that they are often known as strategic business partners within their organizations.

From a client’s perspective there are several impacts of technology on the accounting function as well. In an article discussing the way technology is transforming the “Big 4”, the idea of client portals is discussed. Innovation within the audit software has allowed a seamless communication and sharing of documents between the external auditor and the client. EY has over 50,000 client input portals where clients can safely transfer sensitive information and documents to the auditors assigned to that specific client. This transfer of documents and information is available at a frequency unlike any seen before in the accounting industry. There is an incredible ease with which information flows between the client and the auditor due to the 24/7 nature of technology (Cohn, 2017).

By having an interface such as the ones developed by EY, thousands of emails and calls are eliminated, as well as, the possibility of losing/misplacing confidential information. This is

yet another a consequence associated with technology. By having such a seamless, instant transfer of details, the human connection of meeting with the client's employees or internal auditors disappears. There is less of a personal association with someone when their name appears on a source document. In current time it is entirely possible, and even probable, that someone with whom an external auditor collaborates with at the client site sits 50 feet away and has no idea what the other person looks like.

There is an element of human connection which is dwindling between the client and the auditor. The ramifications of having less of a relationship between a client and the auditor greatly impacts accountants and the firms they work for. With less of a relationship the auditor has less face-to-face time with the client to sell other services the firm offers: such as business consulting or new technological services such as the sale of RPA systems mentioned above to the client. In addition, with less of a personal tie the client does not have as strong of a sense of loyalty to the auditor. Instead of considering the history between the two businesses and the personal ties between the executives of the company and the audit partner, the focus will be on whichever auditor can offer the lowest price.

Another effect of using audit software to store confidential data is the consideration of how likely it is for theft of or misplacing documents. When utilizing a cloud-based data storage the likelihood of losing a single document is much smaller. However, even though there is a low risk of occurrence, a breach in security with data stored in the cloud would bring a much higher level of exposure and cost because the intruder/hacker will be able to access every document stored on the servers.

After considering the multitude of changing variables in the accounting industry, it is obvious that the role of a Certified Public Accounting is evolving from day to day. Technology is

becoming even more embedded in the activities of auditors and tax professionals and has become a second language which financial information professionals must be fluent in. As the future of AI still remains unclear, there is no saying what the boundaries of its power will be; however, there will always be the need for a human presence in the workplace to ensure systems are operating properly and the output is within reason.

Over the next few years an individual entering the accounting field will be given the opportunity to work on advanced assignments much more quickly than ever before, while sacrificing some of the menial labor that could prove to be essential to the development of a strong accountant. Only time will tell whether missing out on the tedious work will have serious enough repercussions to outweigh the benefits of focusing on higher-level tasks.

In current time, the education and training background which an individual receives from universities and on-site at an accounting firm will aid in the transition to the business world. This curriculum will continue to change year by year as information systems are modified and entirely new systems are developed and implemented.

Business professionals will not be the only ones affected by advanced technology. Accounting firms and their clients will have to make serious commitments to research and development in order to stay relevant and ahead in a highly competitive industry. Accounting firms can either develop their own proprietary software, or acquire technology companies, to adapt to the changing environment. In addition, the typical education background of its personnel will be evolving to include a much higher percentage of individuals with a data science/information systems background. In order to ensure success in one's future accounting career, an individual will have to stay current with the unending advances in technology as well as maintaining a high proficiency in accounting principles. While the long-term future of the

accounting industry is not yet known, the foreseeable future shows that Certified Public Accountants are not going anywhere. In a Forbes article, Johnathon Gass states, “Ultimately, though, AI creates new opportunities. Accountants and financial professionals take on more important roles with corresponding compensation. Those who are ready for the future will find that their future is even brighter” (Gass, 2018).

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